

TITLE OF THE INVENTION: optical stack of laminated removable lenses for face shields, windows, and displays

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CROSS REFERENCE TO RELATED APPLICATIONS

none

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to the following areas of

2 technology: Apparel - Guards and Protectors: for wearer's head

1 and face; eye shields such as goggles having a lens-cover plate;
2 and windshield covers.

3 2. Description of the Prior Art:

4 Face shields are employed in environments where
5 contamination of the eyes may occur. It is well known in the art
6 that flexible transparent lenses affixed by numerous methods are
7 overlaid on the face shield for protection. The lenses are easily
8 removed and discarded when visibility is reduced from the
9 accumulation of dirt or other contaminants. In motor sports for
10 instance, multiple layers of transparent lenses are overlaid on
1 the face shield, each being sequentially removed as they become
2 contaminated, because they reduce the visibility of the operator.
3 The drawback of the lenses in the prior art is that each
4 transparent lens applied over the face shield is itself a
5 hindrance to good visibility due to its optical index of
6 refraction. Most common materials used as plastics have optical
7 indexes of refraction ranging from 1.47 to 1.498. The index
8 mismatch between the removable lens and air (air has an optical
9 index of 1.00) causes a reflection of 4% of the light that would
0 normally come to the operator's eyes. This reflection effect is
1 additive for each additional surface to air interface. Then for

1 each removable lens having two surfaces, the reflections are 8%.
2 Thus a stack of seven lenses would reflect 42% of the light away
3 from the operator thereby reducing the brightness of the objects
4 viewed. A second optical phenomenon occurs simultaneously that
5 also reduces visibility. The reflections are bi-directional and
6 thus make the lens stack appear as a semi-permeable mirror to the
7 operator. This mirror effect further reduces visibility, because
8 the light that passes through the lens stack reflects off of the
9 operator's face and then reflects off of the lens stack into the
0 operator's eyes. The effect to the operator is that he sees his
1 own image on the inside of the stack nearly as brightly as the
2 objects viewed on the outside. This significantly reduces
3 visibility.

4 Another drawback to this stacking arrangement is that

5 moisture exhaled by the operator's breath can cloud or fog-up the
6 lenses also reducing visibility. The air spaces between each lens
7 allows the moisture to enter this area.

9 SUMMARY OF THE INVENTION

0 An object of the present invention is to provide a series of
1 easily removable optically clear lens stacks that do not cause

1 reflection to the operator's eyes. The prior art discloses
2 reflective lens stacks that do cause reflections to the
3 operator's eyes. An example of this type of prior art of
4 reflective lens stacks is disclosed in U.S. Patent No. 5,592,698
5 issued on Jan. 14, 1997 to Woods.

6 Refraction is the change in the direction in which waves
7 travel when they pass from one kind of matter into another. Waves
8 are refracted (bent) when they pass at an angle from one medium
9 into another in which the velocity of light is different. The
10 amount that a ray of a certain wavelength bends in passing from
11 one medium to another is indicated by the index of refraction
12 between the two mediums for that wavelength. The index of
13 refraction indicates the amount that a light ray bends as it
14 passes out of one substance and into another. When light passes
15 from air to a denser substance, such as Mylar film, it slows
16 down. If the light ray enters the Mylar film at any angle except
17 a right angle, the slowing down causes the light ray to bend at
18 the point of entry. This bending is called refraction. The ratio
19 of the speed of light in air to its speed in the Mylar film is
20 the Mylar film's index of refraction.

21 The present invention includes a series of alternating

1 optically clear films whose indexes of refraction are matched to
2 within .2 and which will nearly eliminate all reflections to the
3 operator's eyes. The layers of film are adhesively laminated to
4 one another and are compliant so there is no air between the
5 layers. The film layers can be large and generally rectangular in
6 shape with a tab extending from each of the film layers. The tabs
7 can be staggered so that the user can remove the top most layer
8 and then the next succeeding layer. This embodiment of the
9 present invention can be applied to race car windshields,
10 windows, visors or direct view displays such as ATM machines that
11 are subject to contaminating environments. Accordingly, the
12 present invention is an adhesively laminated multi-layered clear
13 film adapted to be used on a racer's face shield, or on the
14 windshield of a race car to keep the viewing area clean during
15 the course of a race.

6 BRIEF DESCRIPTION OF THE DRAWINGS

7 FIG. 1 is a perspective view of an off-road wearer's helmet

8 showing one embodiment of the present invention affixed to the
9 face shield of the helmet.

1 FIG. 2 is a front elevational view of the helmet shown in
2 FIG. 1 showing the tab portion without any adhesive for allowing
3 the wearer of the helmet to easily grasp the tab and peel-off the
4 soiled top layer of the present invention.

5 FIG. 3 is a partial sectional view taken along line 3--3 in
6 FIG. 2. This view shows the tension post extending outwardly from
7 the face shield with the left-side end tab portion of the present
8 invention.

9 FIG. 4 is a front elevational view illustrating the present
10 invention before it is affixed to the face shield of the helmet.

.1 FIG. 5. is a top view of the stackable lenses illustrating
.2 seven layers of lens held together by an adhesive applied between
.3 each lens with the thicknesses of the layers of each lens and
.4 applied adhesive highly exaggerated to clearly show the
.5 relationship between the lenses and the adhesive and also to show
.6 the end portions that do not have any adhesive between each lens
.7 layer for forming the removable tab portions at both ends of the
.8 present invention.

9
0 FIG. 6 illustrates a 60" wide roll of film, which will be

1 used to cut out the optical stacks that are illustrated in FIG.
2 4. The gray stripes illustrate the clear adhesive, and the clear
3 stripes illustrate the clear film without adhesive. It is to be
4 understood that the gray stripes are for illustration purposes
5 only, because the adhesive is clear.

6 FIG. 7 is an exploded perspective view illustrating seven
7 sheets of film layer and seven layers of clear adhesive
8 interposed between each sheet of film layer. This embodiment is
9 used for windshields, windows and the like.

10 FIG. 8 is a view of the laminated sheets illustrated in FIG.

11 7 having a rectangular shape with a series of six tabs for
12 removing each top layer of the lenses successively as the
13 uppermost exposed lens layer becomes soiled or otherwise
14 contaminated.

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Detailed Description of the Invention

2 The present invention will now be discussed in detail. As
3 stated above, FIG. 4 is a front elevational view illustrating the
4 present invention 10 before it is affixed to the face shield of
5 the helmet. The top view in FIG. 5 illustrates 7 layers of lenses
6 15 adhesively affixed to each successive lenses. The adhesive
7 layer is numbered 20. The material used to form the lenses is
8 preferably a clear polyester. The lens layers are fabricated from
9 sheets of plastic film sold under the registered trademark Mylar
10 owned by the DuPont Company. The several trademark registrations
11 for the mark Mylar list several types of products sold under that
12 mark, and include polyester film. The type of Mylar used in the
13 present invention is made from the clear polymer polyethylene
14 terephthalate, commonly referred to as PET, which is the most
15 important polyester. PET is thermoplastic--that is, it softens
16 and melts at high temperatures. Uses of PET film include magnetic
17 tapes and shrink wrap. The adhesive 20 used to laminate the
18 lenses together sequentially is a clear optical low tack
19 material. The thickness of each lens will range from .5 mil to 7
20 mil (1 mil is .001"). The preferred thickness will be 2 mil. Even
1 after the adhesive material is applied to a 2 mil thickness lens,
2 the thickness of the 2 mil thickness lenses will still be 2 mil.

1 The adhesive has nominal thickness. As illustrated in FIG. 5,
2 after the seven layers of film and the six layers of adhesive are
3 laminated together, the overall thickness of the end product is
4 15 mils. The term "wetting" can be used to describe the
5 relationship between the laminated film layers. When viewing
6 through the laminated layers, it appears to be one single piece
7 of plastic film. No reflections are evident. The end tab portions
8 without the adhesive exhibit reflections are not a hindrance to
9 the user, because these end portions are folded back over the
10 posts as illustrated in FIG. 3, and do not affect the visibility
11 of the user.

12 The adhesive material 20 will be a water-based acrylic
13 optically clear adhesive or an oil based clear adhesive, with the
14 water based adhesive being the preferred embodiment. After the
15 seven layers are laminated or otherwise bonded together with the
16 adhesive layers, the thickness of each adhesive layer is
17 negligible even though the adhesive layers are illustrated in
18 FIGS. 4 and 5 as distinct layers. FIG. 5. is a top view of the
19 stackable lenses illustrating seven layers of lens held together
20 by an adhesive applied between each lens with the thicknesses of
21 the layers of lenses and applied adhesive highly exaggerated to
22 clearly show the relationship between the lenses and the adhesive

1 and also to show the end portions that do not have any adhesive
2 between each lens layer for forming the removable tab portions 25
3 at both ends of the present invention.

4

5 The individual stackable lenses package, illustrated in FIG.

6 5 for use with racing helmets, can be fabricated from a roll of
7 film as illustrated in FIG. 6. The film in FIG. 6 includes seven
8 layers of clear polyester film, and having the water-based

9 acrylic adhesive laminating the seven film layers to one another.

10 Keep in mind that each layer of the lenses can be easily peeled

11 away as the top layer exposing the next clean lens. Each

12 succeeding lens layer can be removed as the top lens becomes

13 contaminated with dirt and grime during racing conditions.

14 Referring back now to FIG. 3. As previously stated, FIG. 3

15 illustrates the tension post 60 extending outwardly from the face

16 shield 55 with the left side end tab portion 25 of the present

17 invention illustrated. The face shield 55 has a left tension post

18 60 and a right tension post 65. The present invention 10 has the

19 following dimensions: 18" in length; 2 1/2" in height; and about 15

20 mils in thickness (1 mil is .001"). The present invention is

21 symmetrical about its vertical medial axis and about its

22 horizontal medial axis. The left end has a removable tab portion

1 25, and the right end has a removable tab portion 35. The area 15
2 indicates where the adhesive 20 is applied to the layers of the
3 lens 15. The bilateral demarcation lines 31 and 41 indicate where
4 the adhesive stops on either side. The demarcation lines 31 and
5 41 also indicate where the tab portions begin. The present
6 invention has a pair of bilateral keyhole-shaped slots 27 and 37
7 for demountably engaging the two helmet posts 60 and 65
8 respectively. The curved distance between the two helmet posts 60
9 and 65 is the same as the distance between the centers of the
10 pair of slots 27 and 37. The user secures the lenses to the face
11 shield by positioning the slots adjacent the helmet posts and
12 passing the posts through the slots. It is preferable that the
13 remainder of the tab portion outboard from the slot be folded
14 back upon itself so that the finger hole is also passed through
15 the helmet post. This is illustrated in FIG. 3. The proper
16 installation of the present invention on the helmet requires the
17 user to position the bottom lens of the stack through the post
18 hole by passing the post through the slot, then folding back the
19 remainder of the tab portion 25 so that post passes through the
20 finger hole 29. This is done for each lens working from the
21 bottom up until the tab portion 25 of the top lens extends
22 unfolded as illustrated in FIG. 2. In this manner, the helmet
23 wearer can easily put his index finger through the finger hole

1 topmost lens layer. The clean layer below the removed layer is
2 then exposed and the removal tab portion on the exposed layer
3 will spring back to the unfolded position to expose the finger
4 hole so that the helmet wearer can easily remove that layer after
5 it becomes soiled and contaminated. The plastic material forming
6 the lenses is resilient and will spring back to its unfolded
7 position and extend outwardly from the face shield. The
8 thicknesses of the layered lenses and folded tab portions
9 illustrated in FIG. 3 are highly exaggerated to clearly show the
10 folding relationship. In actual practice seven lenses and seven
11 tab portions will be stacked into the space between the end of
12 the post and the outer surface of the face shield. Remember that
13 there is no adhesive between the tab portions. This allows the
14 removal tab portions to fan out. They do not stick to one
15 another.

16 The present invention as shown in the Drawing Figures has
17 removal tab portions at both ends. This allows a right or left-
18 handed person to easily remove the topmost layer. It also allows
19 the driver to pull the tab with either hand depending on the
20 circumstances of the race. It is to be understood that the
21 present invention includes a laminated lenses with only a left

1 tab portion 25, or only a right tab portion 35, or both a left
2 and a right tab portion.

3 The windshield embodiment 100 illustrated in FIGS. 7 and 8
4 will now be discussed in detail. An optical stack of removable
5 lenses for affixing to an optical window such as a racing car
6 windshield is disclosed in FIG. 8. The embodiment 100 has a
7 plurality of seven generally rectangular superposed removable
8 lenses 105 adhesively affixed to one another. The outer perimeter
9 is continuous. Each of the removable lens 105 is held to each
10 successive lens with a clear uninterrupted adhesive layer 110
11 interposed between each of the removable lens. The perimeter has
12 at least one generally straight edge portion 115. In the
13 embodiment illustrated in FIG. 8, the perimeter is rectangular
14 and has four straight edge portions, one for each side. It is to
15 be understood that the invention could be practiced with only one
16 generally straight edge portion. The area adjacent to the
17 straight edge portion 115 has a banded portion 120 that does not
18 have any adhesive affixed to any of the layers of film to assist
19 in allowing each said film layer 105 to be peeled off
20 successively along the straight edge portion. A plurality of
21 staggered tabs 125 are affixed to the film layers one-at-a-time.
22 The tabs 125 extend from the straight edge portions 120 to assist

1 the user in removing the uppermost soiled and grimy film layer,
2 and to successively remove each next clean layer as the top
3 exposed layer becomes contaminated.

4 The adhesive layer can be foreshortened so as to expose
5 successively a portion of the lens layers without optical wetting
6 to create a grasping tab.

7 The stack of removable lenses as illustrated in FIGS. 7 and
8 8 can have an optically clear adhesive as the bottom last layer
9 to aid in mounting the stack of lenses to the windshield. The
10 stack is affixed to the windshield in much the same way that
11 tinted window plastic film is affixed to a window. The windshield
12 is sprayed with water and the bottom adhesive layer with the
13 stack is then applied to the windshield. Air bubbles and the like
14 are eliminated with a squeegee appliance. The bottom layer
15 becomes "wetted" to the windshield.

16 The stack of removable lenses 100 can be applied to any type
17 of optical window such as windshield, window, face shield, or a
18 video display. It is common at an ATM terminal to have a video
19 display for the customer. The surface of the display can be kept
20 clear by using the present invention.

herein in what is conceived to be the best mode contemplated, it is recognized that departures may be made therefrom within the scope of the invention which is therefore not to be limited to the details disclosed herein, but is to be afforded the full scope of the invention.